

## **Andean glaciers vanish, add socio-economic strains**

*Dirk Hoffmann*

The failure to reach a new binding agreement on emission cuts for carbon dioxide and other greenhouse gases at the December 2009 United Nations Climate Change Conference held in Copenhagen imperils glaciers worldwide — not only polar ice caps but also tropical glaciers that are located in equatorial mountain ranges. What still remains of the world's tropical glaciers, more than 95 per cent of which are found in the four Andean countries of Bolivia, Colombia, Ecuador and Peru, is doomed to disappear within the next few decades, threatening many livelihoods.

### **The evidence**

There has been a rapid retreat of all glaciers since 1980 in Bolivia, Colombia, Ecuador and Peru: studies indicate they lost between a half and a third of their volume. The Andean tropical glaciers are especially vulnerable because of the absence of winter precipitation, a situation aggravated by the more frequent recurrence of the El Niño Southern Oscillation phenomenon, an ocean-warming and atmospheric disturbance originating in the Pacific that results in insufficient rainfall or prolonged drought. Further, these being mainly small glaciers of less than one square kilometre in surface area, they are more climate-sensitive and are melting faster than larger glaciers.

To make matters worse, the Intergovernmental Panel on Climate Change — established by the United Nations Environment Programme and the World Meteorological Organization— projects that temperatures will rise faster at higher altitudes. Measurements from the last 30 years confirm this tendency.



Photo: Dirk Hoffmann

The icy remains of a small glacier with only a few years left in the Tuni region, Cordillera Real, Bolivia in January 2010.

## **The impacts**

The accelerated retreat of the Tropical Andes glaciers has devastating regional and local impacts. As natural water storages with regulating functions, over centuries glaciers accumulate precipitation in the form of snow during the wet season and release melted water during the dry season, guaranteeing a minimum ecological stream flow —the necessary amount of water to preserve aquatic life and minimize pollution— in mountain rivers and brooks, and providing farmers, hydro companies or water enterprises with water when it is most needed.

Glacier retreat will affect the hydrological cycle and hence carry important consequences in terms of water availability for urban and rural populations, production of hydro energy, conservation of flora and fauna as well as equilibrium of mountain ecosystems. In fact, glaciers play important roles well beyond mountain areas.

The Andean glaciers meltdown will have its greatest impact in Peru, where more than 70 per cent of the world's tropical glaciers are located. In addition, millions of Peruvians live on its semi-desert coastal plains —either in the capital, Lima, or other large cities— and depend almost exclusively on the water captured in the mountains to sustain their livelihoods. Peru will also grapple with important economic strains; for the Río Santa power plant alone, which runs on the heavily-glaciated Cordillera Blanca in northern Peru, a 2006 World Bank study estimates that this meltdown could cost the country anywhere between US\$6 and US\$72 million. The same study calculates that Peru will have to spend over US\$100 million in water supply for the eight million inhabitants of the greater Lima area once glacial melt has come to a halt.



Photo: Dirk Hoffmann

Milluni reservoir at its historic low with Huayna Potosí mountain in the background in November 2009.

In the case of Bolivia, researchers claim that over the last 50 years, half of the glacier area has melted in the Tuní Condoriri catchment area, which provided much of El Alto's and some of La Paz' water supply, as reported by the French-led program GREAT ICE (Glaciers et ressources en eau d'altitude — Indicateurs climatiques et environnementaux). In 20 to 30 years' time, the area will be completely ice-free.

Even where global warming is seen as an opportunity to expand agricultural activity to new, higher areas as freezing levels move up —as is happening in some parts of the Apolobamba mountain range in northern Bolivia— new problems arise when rainfall diminishes or when the uphill use of water resources leads to conflict with traditional downhill water users.

Ecuador is already bringing water from the wet oriental Andean slopes to its two million inhabitants living in Quito. Not only is such a water diversion scheme very costly, but it has a high potential for conflict as this water will no longer be available in its region of origin; glacier retreat will only reinforce the current strain.

Colombia's glaciers play a less important economic role and thus their retreat will not have a resounding impact on its population but it is nevertheless disquieting to know they are expected to completely disappear by 2020, as recently calculated by Colombian researchers Germán Poveda and Ketty Pineda.

## **Political and societal responses**

Awareness of the implications of glacier retreat for human activities has been growing very slowly over the last few years among the Andean population. Many mountain communities are not yet fully aware of the changes the meltdown of glaciers will impose on their living conditions. At present, they enjoy the extra amounts of water that the glaciers are releasing. However, for most of the poor peasants throughout the central Andes, climate change is a novel reality that will hit as an additional strain in their fight for daily survival.



Photo: Dirk Hoffmann

The last remains of what used to be the world's highest ski slope with a lift on Chacaltaya in November 2009.

The future holds large potential for conflict in many regions; these conflicts will create highland-lowland clashes as well as rural-urban ones. Yet, the Andean countries neither have strategies for pre-emptive measures nor comprehensive mitigation plans for climate-induced glacier retreat; at best, they are in the course of elaborating them. Governments do not even have a clear idea of the quantity of water stored in glaciers and of what is being lost every year; determining this is an urgent task. As the impacts of glacier retreat are strongly felt at local levels, local authorities need to play their role in the elaboration of strategies to adapt to the changing environment.

Glaciers are excellent indicators of climate change because of their high sensitivity to temperature fluctuations. Their meltdown is also the most visual expression of global warming. However, it must be emphasized that the impact of climate change on biodiversity or forests may be just as important if not as visible. Clearly, glacier retreat is only the tip of the climate change iceberg.

What is more, the world is currently experiencing the effects of less than a one-degree Celsius global warming, while climate scientists worldwide expect a warming of five or six degrees by the year 2100.■

*Dirk Hoffmann is the Director of the Bolivian Mountain Institute (BMI), a non-profit foundation based in La Paz. He is also the coordinator of the Climate Change Research Program at the Ecological Institute of the Universidad Mayor de San Andrés (UMSA), in La Paz, Bolivia. His most recent article "Climate Change and Protected Areas in Bolivia" presented in November at Climate 2009, an international scientific conference, will be published next spring. For more information contact [bolivian-mountain-institute@gmx.net](mailto:bolivian-mountain-institute@gmx.net).*